# *Ceiba pentandra* (L) Gaertn. Ceiba, Kapok, Silk cotton tree

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**Bombacaceae Bombax family**

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Ceiba, *Ceiba pentandra* (L.) Gaertn., also known as sumauma in Brazil and pochote in Mexico, is the largest tree of tropical West Africa and one of the largest and fastest growing trees of tropical America (fig. 1). Ceiba can attain a height of more than 50 m, a d.b.h. of 2 m or more, and an extensive canopy; the stem develops stout spines and prominent buttresses. Although it has a wide variety of uses, ceiba is best known for its production of silk cotton, also known as kapok.

## HABITAT

### Native Range

Although the genus *Ceiba* is considered of American origin, *C. pentandra* grows naturally in the humid and subhumid tropics of America and Africa (fig. 2). It was thought to be native to Southeast Asia, where it had been present as early as the 10th century A.D. *(36),* but genetic evidence suggests it was introduced from Africa *(33)*.

### Climate

In their study of the life zones of Costa Rica, Holdridge and others *(14)* found ceiba in the tropical dry, moist and wet, and the tropical premontane moist and wet forest life zones. *Ceiba pentandra* was present on sites that had mean annual precipitation ranging from 1525 to 5700 mm, temperatures ranging from 23.3 to 27.7 °C, a dry season ranging from 0 to 6 months, and were not affected by frost. Ceiba grows naturally at elevations of up to 1,220 m but its productivity is optimal to about 460 m *(8, 26)*. Optimal climatic conditions include lack of strong winds, abundant rainfall during the growing season, and a dry period from the time the flowers appear until the pods mature *(36)*. In nine planting trials in Costa Rica, the best results were obtained at two sites below a 310-m elevation, where precipitation ranged from 3000 to 3400 mm and mean annual temperatures from 24 to 26 °C *(13)*. Night temperatures of less than 16 °C inhibit fertilization *(35)*.

### Soils and Topography

Ceiba trees grow on soils where the pH ranges from 4.7 to 6.9, with sandy to clayey textures *(14),* but they are best suited to well-drained loams with deep subsoil *(26, 34)*. In Puerto Rico, ceiba trees grow on dry coastal soils where the pH is about 8.0[1].

### Associated Forest Cover

Due to its high light-demanding character *(2)* ceiba is most common in very open habitats such as riverbanks, deforested slopes, abandoned agricultural land, forest gaps, and secondary vegetation *(8, 17, 30, 35),* but it is also present in closed natural forests. In Trinidad, ceiba is found in the *Carapa guianensis* Aubl.—*Eschweilera subglandulosa* (Steud.) Miers association of the evergreen seasonal forest, in the *Peltogyne porphyrocardia* Griseb. association and the *Trichilia Smithii* C. DC.—*Brosimum alicastrum* Sw. association of the semievergreen forest, and in the *Bursera simaruba* (L.) Sarg.—*Lonchocarpus* spp. association of the deciduous seasonal forest (*3*). On the Gold Coast it is found in the *Triplochiton* sp.—*Piptadenia* sp. preclimax forest and in edaphic units above mangrove vegetation (*6*). In Puerto Rico, ceiba can also be found as a member of the *Dacryodes excelsa* Vahl—*Sloanea berteriana* Choisy association[2].

[1]Personal communication with John K. Francis and Frank H. Wadsworth, Institute of Tropical Forestry, Southern Forest Experiment Station, USDA Forest Service, Río Piedras, PR.

[2]Personal communication with Frank H. Wadsworth, Institute of Tropical Forestry, Southern Forest Experiment Station, USDA Forest Service, Río Piedras, PR.

**Figure 1.**—*Trees of ceiba* (Ceiba pentandra) *after leaf fall.*

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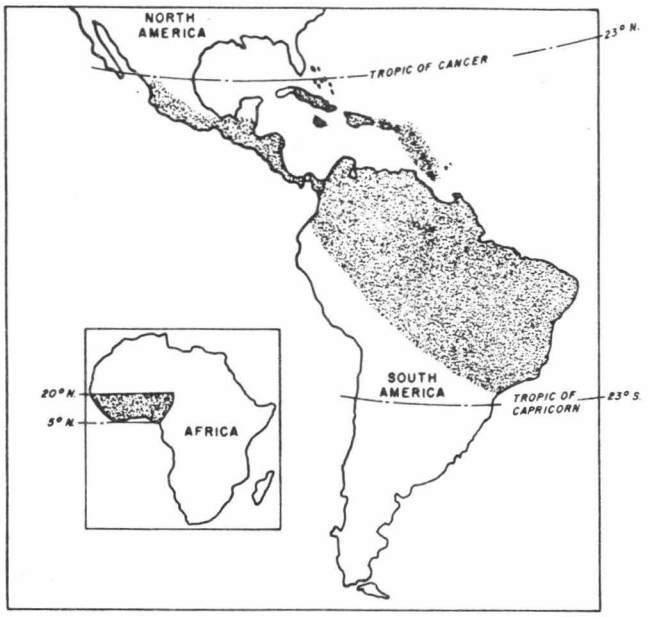


**Figure 2.**—*Shaded area represents the native range of ceiba* (Ceiba pentandra).

## LIFE HISTORY

### Reproduction and Early Growth

**Flowering and Fruiting.**—Flowering generally begins when trees are 5 to 6 years old *(19)*. The trees produce many showy hermaphrodite flowers, usually during the leafless period *(18, 35)*. Flowering seasons vary geographically: in Java, flowering takes place in May *(36)*; in Mexico, flowering is from January to March *(32)*; in Puerto Rico and the Dominican Republic, flowers appear from December to February *(17, 18)*; and in West Africa, flowering is from December to January *(8, 35)*. Although birds, insects, and mammals have been observed visiting ceiba flowers *(32)* some observers have concluded that they are pollinated by birds and bats only *(32, 35)*. Serville, however, reported a doubling of seed pod production by keeping beehives close to the trees *(28)*. The fruits mature in 2 to 3 months *(16, 19, 30, 35)*.

**Seed Production and Dissemination.**—Seeds are about 6 mm long and yield from 7,000 *(18)* to 45,000 seeds per kilogram *(34)*. One tree can produce up to 1 kg of seeds *(16)*. Because of their small size and the silk attached to them the seeds are widely dispersed by wind.

**Seedling Development.**—The seeds do not require stratification, and they are known to lose their viability after a year *(26)*. Germination, which is epigeal *(35)*, takes place about 12 days after sowing *(30)*. The germination rate ranges from 50 to 85 percent *(34)*. Growth is very rapid and compares favorably with other African pioneer trees like *Musanga cecropioides* Br., *Chlorophora excelsa* Benth. and Hook, and *Terminalia ivorensis* A. Chev. *(23)* and with several Central American species *(2)*. Seedlings may reach a height of 23 cm after 8 weeks in the nursery, at which time they are ready for transplanting. The leaves should be removed from the seedlings before planting *(26)*.

**Vegetative Reproduction.**—The tree coppices well and is easy to grow from branch cuttings *(17, 19, 35)*. However, budding produced smaller and less vigorous plants with lower survival than plants reproduced from seeds *(24)*.

### Sapling and Pole Stage to Maturity

**Growth and Yield.**—Ceiba has been studied more for its production of silk-cotton than for wood production, and most of the information is from silk-cotton plantations. Planting of seedlings in rows 8 to 10 m apart has resulted in a height growth of 5 m in 5 years *(19)*. In another study where planting had been in rows 5.5 m apart the height growth was 1.2 m in 6 months *(26)*. After 37 months in nine trials in Costa Rica, survival was 82 to 94 percent, d.b.h. growth was 3.2 cm/yr, and height increment of 1.6 m/yr *(13)*. Where light was plentiful, sapling increments of 2 m/yr or more have been reported *(30)*.

**Rooting Habit.**—Roots tend to crack roads and buildings *(35)*. Older trees in Puerto Rico are known for their large buttresses and large surface roots.

**Reaction to Competition.**—Being a light-loving species *(2, 23)*, ceiba does not withstand initial shade. In Puerto Rico, failures in several plantations have been attributed to competition from herbaceous vegetation[3].

**Damaging Agents.**—Several insects have been reported to attack different parts of the tree. For example, *Pericallia ricini* Fabr. *(31)*, *Oiketicus kirbiyi* Guilding, *Bucculatrix* spp., *Eulepidotis modestula* (Herrich-Schaeffer), *Ephyriades arcas* (Drury), and *Diaprepes abbreviatus* (L.) have been reported as defoliators *(20)*; *Dysdercus andreae* (L.) *(20)* and *D. bimaculatus* *(10)* as seed eaters; and *Analeptes trifasciata* Fabr. and *Paranaleptes reticulata* Thoms. *(15)* as tree girdlers. Other pests include *Mudaria variabilis* Rpke, *Alcides leeuwenii* Heller, and *Nisotra javana* Motschulsky *(36)*. The wood is attacked by an unidentified stain fungi *(18, 35)* and by *Corticium* sp., *Ramularia* sp., and *Fomes* sp. *(36)*. Ceiba is an alternate host of the virus that produces the swollen shoot disease of cacao and the cotton stainer *(30)*. It is also host to parasitic plants of the genus *Loranthus* *(36)*.

Ceiba leaves are readily eaten by cattle, goats, and sheep *(5, 8)*, so grazing animals should not be allowed in plantations until the trees have grown tall enough to avoid this potential defolation *(26)*. Ceiba trees are not resistant to fires *(8, 28)*.

## SPECIAL USES

Ceiba wood is variable in color, from white *(8)* to light brown, but its color may be darkened by sap-staining fungi *(18, 35)*. The wood is very light with a specific gravity of 0.25 g/cm$^3$ *(7)*. The rate of air seasoning and amount of degrade are moderate. The wood machines easily but not satisfactorily. Machining characteristics are: excellent planing, sanding, and resistance to screw splitting; but shaping and boring are poor; turning is very poor; and mortising is fair *(18,*

[3] From memos at the Institute of Tropical Forestry, Río Piedras, PR, written by Frank H. Wadsworth and Jose Marrero.

*7)*. Logs and lumber are very susceptible to insect and fungal attack, but preservation treatment is easy, with good absorption and penetration using either pressure-vacuum systems or open-tank methods. The wood is easy to peel for veneers. Mechanical properties at 12-percent moisture content include: bending strength, 4,330 psi; module of elasticity, 540,000 psi; and maximum crushing strength, 2,380 psi *(7)*.

Reported uses for ceiba's wood include plywood, packaging, lumber core stock, light construction, pulp and paper products, canoes and rafts, farm implements, furniture, matches, and fuelwood *(4, 7, 8, 18, 34)*. In a study of the wood fiber characteristics of 13 tree species ceiba was ranked first for paper production according to fiber length, flexibility, slenderness, and Runkel's ratio *(29)*. Pulp yields of 33 to 37 percent with 95-percent alpha cellulose have been obtained *(1)*. The buttresses have also been used for tables, doors, plates, and trays *(8)*.

Silk cotton, usually called kapok, which is made from the fibers of ceiba fruits, is the most important product derived from this tree. The fibers represent 21.1 percent of the dry weight of the fruit *(16)* and are used for pillows, mattresses, lifebelts (200 to 300 grams can keep a man afloat), and textiles *(8, 18, 19, 35)*. Techniques for cultivation and processing of silk cotton have been described *(26, 36)*. The first kapok crop is borne in the third year *(25, 36)*, and production peaks (up to 600 pods or about 2.7 kg/tree) by the ninth or tenth year *(25, 26, 36)*. Trees continue to yield silk cotton until 50 or more years old *(19)*.

Ceiba is one of the sacred trees in West Africa and in the Mayan and Taino cultures *(8, 12, 22)*. It is used as an ornamental and a shade tree *(17, 22, 27)*. The bark furnishes a red fiber used for ropes and paper in India, and the bark is also used as a medicine for wounds and intestinal disorders *(22)*; the leaves have emollient properties, and a decoction of the flowers is used for constipation *(8)*. Nectar from ceiba flowers serves as a source of honey *(17, 28)*. The oil obtained from the seeds (22 to 25 percent of the seeds' weight) has been used for lubrication, lamps, culinary purposes, soapmaking, and paints *(8)*.

Ceiba is used as a fodder tree for cattle, goats, and sheep *(5, 8)*, and its flowers and seeds are also eaten by stock *(5, 22)*. Its leaves contain 24 percent protein when young and 14 percent when old (N x 6.25) *(21)*. In Indonesia it is considered ". . . the most promising agroforestry species when fodder is in short supply" *(11)*.

## GENETICS

There are about 10 species in this genus, and all are endemic to South America. Botanical synonyms include *Bombax pentandrum* L., *Eriodendron anfructuosum* DC., *B. guineense* Thonn., *E. guineense* (Thonn.) G. Don., *C. thonningii* A. Chev., and *C. guineense* (Thonn.) A. Chev. *(35)*.

Ceiba's diploid chromosome number has been reported as 72 and 80 for the Southeast Asian and African varieties and 88 for the *C. indica* strains, *C. pentandra v. caribaea* and *C. occidentale (9)*. Southeast Asian genetic stock has been reported as very uniform, with most characters being recessive, while American and African stock is more variable, with most characters being dominant *(33)*. In west tropical Africa trees grow with or without spines, producing both dehiscent or nondehiscent fruits or different sizes and shapes and with different branching patterns. However, these features may be responses to growing conditions and not hereditary *(8)*.

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